Replacement of aggregate in concrete by using black cotton soil and flyash

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Abstract - *In current era of construction there has been a rapid increase in demand of construction materials and fine aggregate or sand used in construction is depleting at a very fast rate. Hence there is need of replacement of fine aggregate so as to reduce the use of sand in construction. Waste products from various industries normally deposited in landfills and dormant materials can be used as alternate construction material. The utilization of these materials need to be encouraged for economy of construction and conservation of material. Fly ash and black cotton soil are one such alternatives which are available in abundance and very economical. They can be replaced as fine aggregates in concrete. Experimental investigation is carried out to evaluate mechanical properties of concrete by replacing fine aggregate by black cotton soil and fly ash. Fly ash and black cotton soil are used as they have similar properties of sand. Use of fly ash with black cotton soil also has advantage as fly ash stabilizes the black cotton soil and improves its properties. Tests were performed for properties of fresh concrete for compressive strength.*

Key Words: fly ash, black cotton soil, concrete, compressive strength, flexural strength

1.INTRODUCTION

Concrete is a material synonymous with strength and longevity. It has emerged as the dominant construction material for the infrastructure needs of the twenty-first century. In addition to being durable, concrete is easily prepared and fabricated from readily available constituents and is therefore widely used in all types of structural systems. The challenge for the civil engineering community in the near future is to realize projects in harmony with the concept of sustainable development and this involves the use of high performance materials and products manufactured at reasonable cost with the lowest possible environmental impact. There are various studies going on to fit materials in place of construction materials without affecting the required strength of concrete. One such construction material that is depleting at a very fast rate is quarry sand which is used as fine aggregate in concrete.

1.1 Aggregate

Aggregates are the important constituents in the concrete composite that help in reducing shrinkage and impart economy to concrete production. Most of the aggregates used are naturally occurring aggregates, such as crush rock, gravel and sand which are usually chemically interactive or inert when bonded together with cement. On the other hand, the modern technological society is generating substantially high amounts of solid wastes both in municipal and industrial sectors; posing an engineering challenging task for this effective and efficient disposal. Hence, partial or full replacement of fine aggregates by the other compatible materials like sintered fly ash, crushed rock dust, quarry dust, glass powder, recycled concrete dust, and others are being researched from past two decades, in view of conserving the ecological balance. In this project an attempt has been made to replace sand by black cotton soil and fly ash.

1.2 Black cotton soil

Black cotton soil is most abundant soil in Maharashtra. A large amount of black cotton soil excavated during construction is simply wasted by dumping. Black cotton soil usually consists of sand silt and clay. The main property of black cotton soil is that when it is subjected to water, it swells up very rapidly and as soon as water evaporates, the soil becomes hard rock like material.

Fig.1.1. Black cotton soil surface

2. FLY ASH

Presently about 105 million tons fly ash is generated every year in India as a by-product of coal consumed in the

thermal power plants. The thermal power plant is only the source to produce 65% of the total electricity produced in our country. Several million tons of coal for generating the electricity is being consumed in India out of which 40% of coal is accounted for generating of fly ash as a bye product. The type of flyash collected at the bottom of boiler furnace having lesser fineness & high carbon content is called bottom fly ash. The finest fly ash is called dry fly ash, collected from different electrostatic precipitators (ESP) in dry form. While the ash mixed with water, forming slurry and drained out in ponds is referred as pond fly ash The mineralogical studies of fly ash reveals that silica is present in crystalline forms of quarts (sio3) and partly is associated with alumina as mullite (2AL2O32Sio2), the rest being mostly in the glassy phase. The huge amount of fly ash imposing challenges for its disposal and management. At present fly ash is disposed in slurry form in large ponds managed by Thermal power corporation plant units. A small percentage that is 3% to 5% of fly ash is being used in India while in other countries the percentage of utilization is 30% to 80%, whatever be the type of fly ash, it causes types of pollution (4) and air born diseases such as silicoses, fibrosis of lungs, bronchitis etc. Due to the presence of toxic metals in fly ash, it causes water pollution through percolation

Table -1: Quantity of Materials per cubic meter for plain concrete Grade M-20

Sr.No.	Material	Wt. in kg/m³
1	w/c ratio	0.50
2	Cement	383 kg/m³
3	Water	191.6 kg/m³
4	Fine agg.	727 kg/m³
5	Course agg.	1103 kg/m³

Table -2: Quantity of Materials per cubic meter of Grade M-20 concrete with replacement of fine aggregate by black cotton soil and fly ash (Without admixture)

Sr.No.	Material	Wt. in kg/m³
1	w/c ratio	0.50
2	Cement	325 kg/m³
3	Water	272.67 kg/m³
4	Fine agg. 1.black cotton soil 2.fly ash	 450.39 kg/m³ 220.35 kg/m³
5	Course agg. 1.10mm 2.20mm	 483 kg/m³ 724.5 kg/m³

Table -3: Quantity of Materials per cubic meter of Grade M-20 concrete with replacement of fine aggregate by black cotton soil and fly ash (With admixture)

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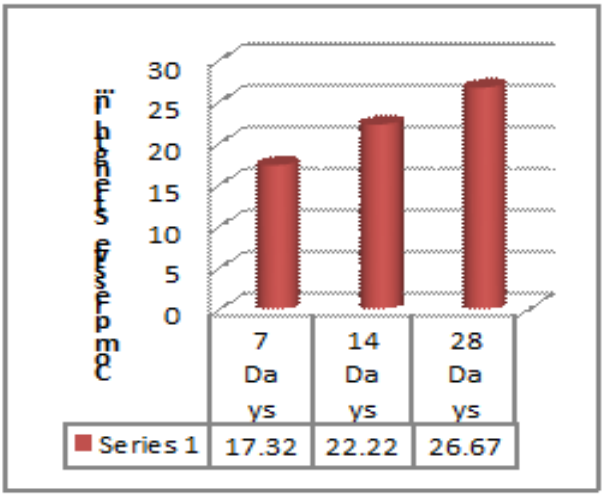
	1.black cotton soil 2.fly ash	220.35 kg/m³
5	Course agg. 1.10mm 2.20mm	 483 kg/m³ 724.5 kg/m³
6	SP. 500	2.72 kg/m³(0.5%)

3. RESULT

Table:4 Standard results of a m20 plain concrete

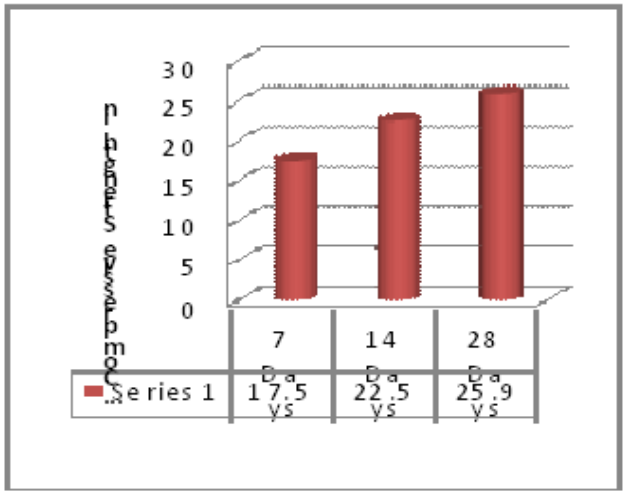
Sr. no	Agg at testing	Crushing load observed on machine	Compressive strength (n/mm²)	Average compressive strength(n/mm²
1	7 DAYS	390	17.33	17.32N/mm²
2	14DAYS	500	22.22	22.22N/mm²
3	28 DAYS	600	26.67	26.67N/mm²



Graph:1 Avg. compressive strength for 7 ,14 and 28 Days for M20 plain concrete

Table 5: Result of compressive strength of m20 concrete by replacing fine aggregate with black cotton soil and fly ash (without admixture)

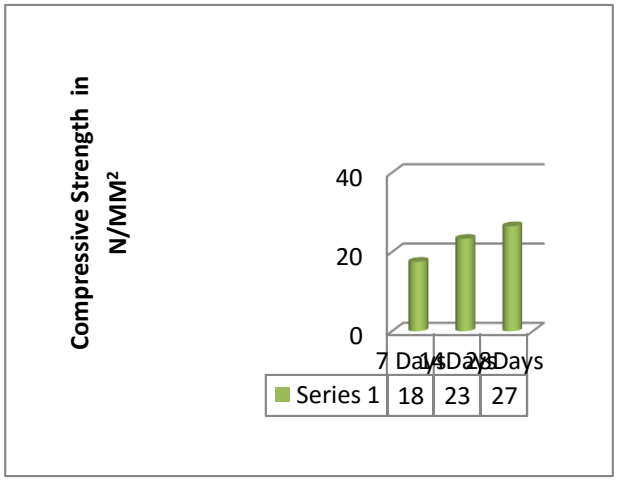
Date of Casting :18/02/2015					
Sr.no	WT.OF SPECIMEN	AGG AT TESTING	CRUSHING LOAD OBSERVED ON MACHINE	COMPRESSIVE STRENGTH (N/MM²)	AVERAGE COMPRESSIVE STRENGTH(N/MM²)
Date of testing : 25/02/2015					
1	8295	7 DAYS	390	17.33	
2	8280	7DAYS	380	16.88	17.32N/mm²
3	8315	7 DAYS	400	17.77	
Date of testing :04/03/2015					
4	8310	14 DAYS	515	22.8	
5	8350	14 DAYS	520	23.11	22.56N/mm²
6	8285	14 DAYS	490	21.77	
Date of testing :04/03/2015					
7	8795	28 DAYS	590	26.22	
8	8450	28 DAYS	580	25.77	25.92N/mm²
9	8560	28 DAYS	580	25.77	



Graph 2 : Avg. compressive strength for 7 ,14 and 28 Days for concrete with replacement of fine aggregate by black cotton soil and fly ash (without admixture)

Table 6: Result of compressive strength of m20 concrete by replacement of fine aggregate with black cotton soil and fly ash (with admixture)

Date of Casting :12/03/2015					
Sr.no	**WT.OF SPECIMEN**	**AGG AT TESTING**	**CRUSHING LOAD OBSERVED ON MACHINE**	**COMPRESSIVE STRENGTH (N/MM²)**	**AVERAGE COMPRESSIVE STRENGTH(N/MM²)**
Date of testing : 19/03/2015					
1	8675	7 DAYS	395	17.55	
2	8600	7DAYS	400	17.77	17.53N/mm²
3	8700	7 DAYS	390	17.33	
Date of testing :26/03/2015					
4	8680	14 DAYS	520	23.11	
5	8540	14 DAYS	525	23.33	23.33N/mm²
6	8675	14 DAYS	530	23.55	
Date of testing :09/04/2015					
7	8700	28DAYS	600	26.67	
8	8655	28 DAYS	590	26.22	26.51N/mm²
9	8680	28 DAYS	600	26.67	

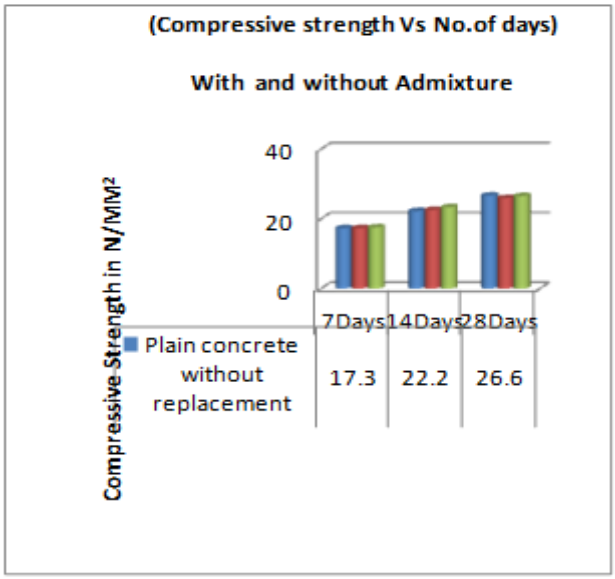


Graph 3: Avg. compressive strength for 7 and 28 Days for concrete by replacing fine aggregate by black cotton soil and fly ash (with admixture)

3.1Comparison & research on compressive strength of cube

Table No -7: Avg. Compressive Strength At 7,14 and 28 Days

SR no	Id mark	Avg Compressive strength (Mpa)		
		7DAYS	14DAYS	28DAYS
1	**Plain concrete**	17.32	22.22	26.67
2	**T1 Concrete by replacing fine aggregate without admixture**	17.32	22.56	25.92
3	**T2 Concrete by replacing fine aggregate with admixture**	17.53	23.33	26.51



Graph 4: Compressive strength Vs No. of days (With and without Admixture)

4. Conclusion

- It is observed from results that concrete with replacement of fine aggregate by black cotton soil and fly ash gives similar strength to that of a plain concrete.
- The compressive strength, increases when admixture is added to the mixture.
- Compressive strength of 7 days and 14 days increased to about 1.2% when fine aggregates are replaced by black cotton soil and fly ash as compared to plain concrete
- Compressive strength of 28 days was almost same of that of plain concrete and of concrete of replaced fine aggregates with very little variation.

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